Project Title:	Development of an artificial intelligence rock type classification and fracture state characterization APP for engineering applications
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Research Institution:	The University of Hong Kong
Subject Area:	Construction Productivity
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Background

Ground investigation (GI) is an important means of assessing the ground and groundwater conditions, which are critical for almost all civil engineering works. Use of poor quality GI data may result in inadequate and unsafe design that could have significant life and economic consequences. In Hong Kong, sinking boreholes in the ground is the most common GI technique. Although all logging geologists in Hong Kong possess the necessary academic qualification and work experience that have been assessed by the government authorities, individual's professional judgement would inevitably influence the accuracy and comprehensiveness of the logs produced, particularly for soil and rock of high natural variability. Therefore, core photographs included in the GI reports provide the most direct means for clients and design engineers to check against the logs. However, this is largely limited to visual assessment as an aid to comprehend the log.

Reaping the benefits of the maturity of computer vision-based deep learning AI technology and the widespread use of smart mobile devices, the proposed study aims to develop a next-generation mobile APP for classifying rock types and determination of fracture indices based on colour core box images. The APP is featured by a well-trained deep learning model and easy-to-use user interface. The aim of the APP is not to replace the entire human input but to harness the latest technology to enhance the productivity of rock core logging and log checking. At the end, it still requires human to make the decision.

Objectives

- To train a number of convolutional neural network models (ConvNets), a type of computer vision-based deep learning AI model for classifying fresh and weathered igneous rocks and minor intrusions, and problematic rocks contained in the labelled photos. The best performing ConvNet will be selected.
- To train a ConvNet based on the holistically-nested edge detection (HED) method for automatically identifying fractures in rock cores; to derive algorithms for calculating the fracture indices used for quantitative description of the fracture state of the rock cores.

Key Deliverables

- A data warehouse containing a labeled image dataset comprising labelled and pre-processed images of different categories of rocks and fractures.
- A computer programme (aka mobile APP) with a user-friendly interface for automatic classification of common Hong Kong rocks and determination of fracture state indices based on user's uploaded rock photographs. A companion user manual will also be prepared.